REMARKS

Applicants' attorney would like to thank the Examiner for the telephonic interview granted on Monday, May 14, 2005. The interview was very helpful in determining areas of this response which required further attention.

In view of the Examiner's comments with respect to Figure 4, applicants' attorney took a closer look at the graph shown in Figure 4. Applicants' attorney had failed to notice that although the spacing between data points on the "days" scale are equidistant, the number of days represented by the equidistant data points are not an equal number of days; in fact, the number of days do not follow any discernable pattern! Upon a closer review, the number of days occurring between equidistant data points on the days scale ranges from as few as 5 days to as high as 90 days, with no discernable pattern in the increase or decrease in the number of days. This means the last data point on the graph in Figure 4 is likely to be at least 5 days later than 365 days, but may be a higher number, up to 90 days later. In any case, it is not possible to determine the number of days at which the last data point on the graph was measured, looking at Figure 4. However, it is clear that the last data point was some number of days after 365 days.

With the above in mind, applicants' attorney has requested that Paragraphs 38 and 113, which were amended in Amendment "B", be replaced with paragraphs in which "up to 370 days" is replaced by "periods ranging from 2 hours up to at least 365 days". In view of these corrections, the Examiner is respectfully requested to withdraw the request that applicants cancel the "new matter" inadvertently placed in the application Specification by Amendment "B".

Claims Rejected Under 35 U.S.C. § 112, First Paragraph:

Claims 16 - 18, 20 - 21, 23 - 24, 28 - 29, and 31 - 32 are rejected under 35 U.S.C. § 112, first paragraph, as failing to comply with the written description requirement for a variety of different reasons. These reasons are addressed individually below.

The Examiner has recommended that Claims 16 and 20 which recite a lower limit for the post application baking of 85 °C be amended to recite a lower limit of 84 °C. Applicants have amended Claims 16 and 20 to recite a lower limit of 84 °C.

The Examiner has argued that the prior art showed stability for up to 2 hours, and that applicants have shown, in Table 4, that the coated substrate is stable for time periods ranging from 1 day up to something (undefined) greater than 365 days. The Examiner has requested that applicants use a lower limit of 1 day in their claims. However, this permits one skilled in the art to use a time period which is greater than 2 hours but less than 1 day at the expense of applicants. Applicants proved that a coated substrate can be stored for a time period greater than 2 hours without affecting the ability to resolve critical features in a subsequently generated photomask by more than 20 nm, compared with critical features which are generated when the coated substrate is not stored, but is further processed into a photomask directly in line after coating of the substrate with the photoresist. Prior art experience had indicated that after a storage time of about 1.5 hours, the change in the critical features due to delay in exposing the coated substrate to patterning radiation was greater than 20 nm.

Figure 3 represents the prior art. Figure 3 shows that a coated substrate which was post apply baked at 90 °C for 60 seconds (one minute) and processed directly in-line to produce a photomask, produces a mean CD of 400 nm. A coated substrate prepared in the same manner, which is stored 1.5 hours after the post apply bake step prior to further processing into a photomask, exhibits a mean CD which has increased from 400 nm to 420 nm. A coated substrate prepared in the same manner, which is stored for 2.0 hours after the

post apply bake step prior to further processing into a photomask, exhibits a mean CD which has increased from 400 nm to about 426 nm (greater than a 20 nm change). After 10 hours of storage of the coated substrate, processing of the substrate into a photomask produces a CD which has increased from 400 nm to about 466 nm. One skilled in the art viewing Figure 3 would conclude that in order to avoid an increase in CD of more than 20 nm, the coated substrate should not be stored for more than 1.5 hours prior to further processing into a photomask.

Despite some minor variation in the measured mean CD of the substrate after processing into a photomask, applicants have shown that the mean critical dimension of photomask features has not changed more than 20 nm when a coated substrate treated according to their post apply bake method is stored for a time period after post apply bake of 1 day up to greater than 365 days prior to further processing into a photomask. Although applicants did not test for a change in critical dimension when the coated substrates were stored for less than one day prior to further processing into a photomask, one skilled in the art will conclude that changes which occur between the initial substrate coating time and the 1 day time period will be less than 20 nm. Thus, applicants have shown that when their post apply bake treatment method is used to treat a coated substrate prior to storage, it is possible to store the substrate for a time period longer than the 1.5 hours of the prior art coated substrate, without the change in critical dimension changing more than 20 nm when the substrate is further processed into a photomask.

Rather than claim right up to the 1.5 hours, where the prior art showed the change in the processed photomask critical dimension was more than 20 nm, applicants claimed a longer time period limit for their invention, where the coated substrate treated by their method was stored for a time period of 2.0 hours. At this time period, without applicants' treatment, the stored substrate would be expected to produce a photomask where the CD had increased by 26 nm. Applicants' independent Claims 16 and 20 each recite a limitation for their treated

coated substrate, where the change of critical dimension in the subsequently generated photomask is less than 20 nm.

The Examiner is respectfully requested to withdraw the grounds of rejection under 35 U.S.C. § 112, first paragraph with respect to the recitation of a storage period of more than 2 hours, as recited in Claims 16 and 20.

The Examiner also discusses the use of a 370 day time period recitation in Claim 24. In view of the error with respect to the scale for days in Figure 3, applicants have amended Claim 24 to recite that the period of storage of the coated photomask ranges from 2 hours up to at least 365 days.

The Examiner is respectfully requested to withdraw the grounds of rejection under 35 U.S.C. § 112, first paragraph with respect to Claim 24, in view of the amendment of Claim 24 to recite a storage time period ranging from 2 hours up to at least 365 days.

The Examiner indicates that Claims 18, 21, and 29 should not refer to a post apply bake having a minimum time of 1 minute in view of Figure 3. Figure 3 pertains to a change in mean CD of photomask features when a substrate coated with a chemically amplified photoresist is stored after post apply bake for various time periods prior to further processing into a photomask. The coated substrate was post apply baked at 90 °C for a time period of 60 seconds (one minute) prior to storage. This was a typical post apply bake used with a continuous in-line processing system, where the photoresist-coated substrate proceeded directly (without storage) to the exposure tool from the post apply bake, and from there to directly into other processing into a finished photomask. This process is described in Paragraph [0112], at Page 34, lines 1 - 13.

As part of the present invention experimentation, coated blank photomask substrates which had been post apply baked at 90 °C for one minute were stored for various periods of

time prior to proceeding to exposure to radiation to produce a pattern in the photoresist, and other processing into a finished photomask. Figure 3 shows that the change in mean CD of a finished photomask as a function of the storage time after the post apply bake (prior to proceeding to exposure and other processing into a photomask).

Applicants showed in a comparative example illustrated in Figure 4, that, by using a specialized post apply bake treatment of the coated substrate, the coated samples could be stored for at least 365 days prior to exposure and further processing into a photomask, without a mean CD change of more than 20 nm. In the example shown in Figure 4, the post apply bake treatment was at 105 °C for a time period of 9 minutes prior to storage of the coated substrate. This is described in Paragraph [0113] at Page 34, lines 18 - 27, continuing at Page 35, line 1.

Applicants' attorney reviewed the data disclosed in the application, as proposed during the Examiner Interview on May 16, 2005, as found reference to a post apply bake set point at 7 minutes, with reference to Figure 6. Figure 6 illustrates that when a post apply bake temperature ranged from about 84 °C to about 115 °C, this provided a change in mean CD of the finished photomask of less than about 20 nm, so long as the post exposure bake temperature was greater than about 46 °C. However, this data is not tied directly to a sample which was stored after coating and prior to further processing into a photomask. We can see from the data provided in Figure 5 that a post apply bake in the range of about 84 °C to about 115 °C provides a fabricated photomask where the mean CD has changed less than 20 nm over a wide window of finishing process conditions. In combination with the data in Figure 5, the data provided in Figure 4 indicates that the 90 °C post apply bake temperature is not the problem with respect to the coated substrates illustrated in Figure 3. The problem is the one minute bake time.

Thus, the present application teaches that a one minute post apply bake treatment time is inadequate to permit a long storage time for coated substrates prior to exposure. We know

that a 9 minute bake time is adequate, and we know that a 7 minute bake time is likely to be adequate, and we know that a 1 minute bake time is inadequate. With this in mind, applicants have drafted their dependent claims to claim a post apply bake treatment time ranging from greater than one minute to about 9 minutes. One skilled in the art, with minimum experimentation, can determine exactly what the lower time limit is for a substrate coated with their photoresist material.

The Examiner is respectfully requested to withdraw the rejection of Claims 18, 21, and 29 under 35 U.S.C. § 112, first paragraph.

The Examiner has argued that there is no support in the Specification for the amendment of Claims 16 and 20 to recite "ambient atmosphere conditions". Applicants' attorney was unable to find any such recitation in Claim 20. With respect to Claim 16, there is support for reciting that the coated substrate, treated using applicants' method, was stored under ambient atmosphere in a clean room. Applicants have amended the Claim 16 recitation to include that the storage was in a clean room at room temperature. The support in the application Specification as originally filed is present in Paragraphs [0037], [0038], [0112] and [0113]. Paragraph [0037] recites that Figure 3 is a graph 300 representing a comparative example of the affect of storage on a substrate coated with photoresist. Paragraph [0038] recites that Figure 4 is a graph 400 illustrating the stability of the coated substrate produced using the method of the present invention (for comparison against the data shown in Figure 3). Paragraph [0112] recites that the photoresist-coated photomask substrate was stored in ambient atmosphere in a clean room at room temperature prior to further processing to produce the photomask. Figure 3 is said to be illustrative of the change in critical dimension in the finished photomask as a function of the time period the coated substrate was stored prior to further processing to produce the photomask. Figure 3 is the comparative example of the problem applicants were trying to solve. Paragraph [0113] describes how applicants solved the

problem, using a chemically amplified photoresist which included a modified phenolic polymer and an onium salt-containing chemical amplifier, and then applying a particular post apply bake of the coated substrate prior to storage of the coated substrate. Figure 4 shows the test results for comparison with the results shown in Figure 3. Applicants stored the treated coated substrates they produced under the same conditions they had always stored the coated substrates – at ambient atmosphere in a clean room at room temperature. If the samples were not stored in the same manner, applicants would have to identify a change in storage conditions or the comparison with the prior art data in Figure 3 could not be made.

The Examiner is respectfully requested to withdraw the rejection of Claims 16 and 20 under 35 U.S.C. § 112, first paragraph.

Claim Rejections Under 35 U.S.C.§ 102(e):

Claims 16 - 28, 20 - 21, 23 - 24, 28 - 29, and 31 - 32 are rejected under 35 U.S.C. § 102(e) as being anticipated by Montgomery et al. U.S. Patent No. 6,605,394.

As previously discussed, the Montgomery et al. patent pertains to a series of steps used to optically fabricate a photomask. The series of steps includes exposing the surface of the DUV photoresist to radiation from a direct write continuous wave laser to produce a pattern (a latent image) within the photoresist. The substrate with the pattern exposed photoresist is subsequently processed into a photomask. (Abstract and Claim 1, for example).

The present invention pertains to a method of increasing the shelf life (increasing the time period of storage possible prior to use, without adverse effects) of a blank photomask substrate. The blank photomask substrate has not yet been exposed to the laser to create a latent pattern image within the photoresist. A blank photomask substrate is referenced in the originally-filed application Specification at Paragraphs [0078] and [0089], for example. "The 257 nm direct write continuous wave laser exposes (images) integrated circuit patterns onto an unpatterned photoresist 1108 coated on a mask blank which includes . . . (description of

various layers deposited on the substrate prior to the photoresist layer deposition). "Prior to exposure, the mask blanks were kept in light-tight bags and in non-outgassing boxes equipped with an integrated sealing gasketing." Clearly the time period which a photoresist coated blank substrate can be stored prior to use is not described or claimed in the Montgomery et al. '394 patent.

At the same time, applicants in the Montgomery et al. '394 patent were required to describe the "best mode" for a photoresist post application bake upon a photomask substrate. Because the present inventors Warren Montgomery and Jeffrey Albelo had knowledge of the present invention at the time of filing of the '394 patent application, and because Warren Montgomery and Jeffrey Albelo were co-inventors of the subject matter of the '394 application, these co-inventors were required to describe a post apply bake cycle which would provide the best results in the '394 patent application. However, there was no discussion or disclosure in the '394 patent application about the use of any one of the post apply bake cycles disclosed for purposes of enabling a longer storage of a photoresist coated substrate prior to exposure to patterning radiation in the '394 patent application. One skilled in the art would produce the photomask in the manner known in the art, where the coated substrate travels directly from the post bake cycle to the patterning radiation exposure cycle in the process without an intervening storage time. As was illustrated in the comparative data shown in Figure 3, prior to the present invention, the photoresist coated substrate could not be stored for more than about an hour or an hour and a half without a significant harmful effect on the photomask subsequently produced.

To have anticipation of the presently claimed invention, the Montgomery et al. patent would need to describe application of the photoresist over a photomask substrate; a post application bake; and then storage of the blank photomask substrate for a period of time which would (based on the prior art) have caused a change in critical dimension of more than 20 nm. There is no description of this kind in the Montgomery et al. patent. In a previous office

action, the Examiner referred to Example 1 at Cols. 11 - 13, which recites that: "The latent image stability in the photoresist should be such that there is less than a 5 nm change in the CD over a 5 hour time period." The latent image referred to is the irradiated pattern which is present in the photoresist. This pertains to changes in the irradiated photoresist rather than to changes in a non-exposed photoresist. This is distinguishable from the shelf life of a photoresist which has not been irradiated.

Applicants contend that the invention claimed in their application is not anticipated by the disclosure provided in the Montgomery et al. reference.

However, due to applicants' need to have the present patent issue without further delay, and since the related subject matter disclosed in the '394 patent does not qualify as prior art under 35 U.S.C. § 102(e), applicants have prepared a Declaration under 37 C.F.R. § 1.132 to traverse this grounds for rejection. In particular, the presently claimed invention was reduced to practice prior to the May 3, 2001 filing date of the patent application for the '394 patent, as illustrated by the Invention Alert attached to the § 1.132 Declaration. Further, the disclosure in the patent application for the '394 patent was not the invention by another, but was based on knowledge of co-inventors of the present invention.

In view of the arguments presented above about the distinctions between the present invention and the '394 patent invention, and in view of the 37 C.F.R. § 1.132 Declaration which accompanies this Amendment "C", the Examiner is respectfully requested to withdraw the rejection of Claims 16 - 18, 20 - 21, 23 - 24, 28 - 29, and 31 - 32 under 35 U.S.C. § 102(e) as being anticipated by Montgomery et al.

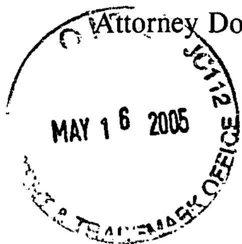
Applicants contend that applicants' pending claims are in condition for allowance, and the Examiner is respectfully requested to enter the present amendment and to pass the application to allowance.

The Examiner is invited to contact applicants' attorney with any questions or suggestions, at the telephone number provided below.

Respectfully submitted,

Shirley L. Church
Registration No. 31,858
Attorney for Applicants
(650) 473-9700

Correspondence Address:
Patent Counsel
Applied Materials, Inc.
P.O. Box 450-A
Santa Clara, CA 95052



Attorney Docket No.: AM-5852 D1 U.S. Express Mail No. ED330970877US

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

IN RE APPLICATION OF: Scott Fuller et al.	§ GROUP ART UNIT: 1756
	§
SERIAL NO.:10/758,827	§ EXAMINER: N. M. Barreca
	§
FILED: January 15, 2004	§
	§
FOR: METHOD OF INCREASING THE SHELF LIFE OF A PHOTOMASK SUBSTRATE	§ Attorney Docket No.:
	§ AM-5852 D1

Date: December 3, 2004

DECLARATION OF INVENTORS UNDER 37 CFR § 1.131

Hon. Commissioner for Patents
Washington, DC 20231

Sir:

1. We, Scott Fuller, Melvin W. Montgomery, Jeffrey A. Albelo, and Alex Buxbaum, hereby declare that we are joint inventors of the invention claimed in U.S. Patent Application Serial No. 10/758,827, the present application. We further declare that said invention was conceived and reduced to practice by us prior to the May 3, 2001 filing date of U.S. Application Serial No. 09/848,859, which issued as U.S. Patent No. 6,605,394 on August 12, 2003.

CERTIFICATE OF MAILING UNDER 37 CFR 1.10

I hereby certify that this paper and any documents said to accompany this paper are being deposited with the U.S. Postal Service on the date shown below with sufficient postage as U.S. EXPRESS MAIL NO. ED330970877US in an envelope addressed to: Mail Stop Amendment, Commissioner for Patents, P.O. Box 1450, Alexandria, VA 22313-1450.

Date: May 16, 2005

Shirley L. Church, Reg. No.31,858

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2. In support of our Declaration, attached is a copy of the Invention Alert which preceded the present patent application. This Invention Alert shows that the invention claimed in the present application was conceived and reduced to practice by us prior to May 3, 2001. Portions of the Invention Alert which pertain to conclusory dates of invention have been dedacted to protect our rights as inventors.

3. We also declare that U.S. Application Serial No. 09/848,859, which was filed on May 3, 2001, (and which issued as U.S. Patent No. 6,605,394) was filed by inventors Melvin W. Montgomery and Jeffrey A. Albelo who are co-inventors of the present application, and that the assignee of the '859 application and the present application is the same, Applied Materials, Inc. of Santa Clara, California. The present work was done in conjunction with the work done with respect to the '859 application. Since the common inventors of the '859 application had the duty to disclose the best mode of their invention at the time of filing their application, and since the best mode included knowledge of the contents of this invention, which was made prior to filing of the '859 application, inventors Montgomery and Albelo disclosed a post apply bake temperature in their application specification which falls within the range of a post apply bake step which is claimed as part of the present invention. This disclosure was not invention by another, but was based on knowledge of co-inventors of the present invention.

4. However, we contend that the Examiner is in error in rejecting the claims in the present invention as being anticipated by the disclosure in U.S. Patent No. 6,605,394. The '394 patent relates to a method of optically patterning a photomask using a series of steps, where an organic antireflection coating is applied over a metal-containing layer on a substrate used for photomask fabrication; a chemically amplified DUV photoresist is applied over the organic antireflection coating; and a surface of the DUV photoresist is exposed to radiation from the direct write continuous wave laser. In an alternative embodiment, the organic antireflection coating may be

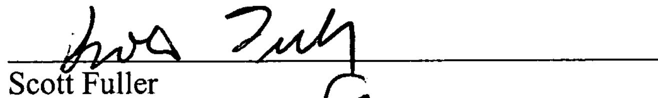
applied over an inorganic antireflection coating which is present over a surface of the metal-containing layer. In the detailed description of the invention in the '394 patent, present co-inventors Montgomery and Albelo, recommend a post apply bake (PAB) at 105 °C for a 7 minute time period (Col. 13, lines 46 - 49), as a part of a series of steps which include: photoresist deposition; a post-apply bake (PAB) step; optical imaging at 257 nm with a continuous write optical imaging system; post-exposure bake (PEB) after imaging; wet development of the latent image in the photoresist to produce a pattern; transfer of the pattern to the underlying photomask structure using a dry etch process; descum/organic ARC removal (for removal of any residual photoresist and removal of the ARC); dry etch of a chrome oxynitride inorganic ARC; and dry etch of the underlying chrome layer. After completion of all of these steps, a reticle with features having a critical dimension of 200 nm is created. For a 132 mm x 132 mm (6-inch) active area, the critical dimension uniformity (CD Range/2) of the patterned mask is typically ≤10 nm at 400 nm. (Col. 16, lines 10 - 14.) The Examiner also cites Col. 12, lines 29 - 31 in the '394 patent to the effect that "There is less than a 5 nm change in CD over a 6 hour time period". However, the actual text reads: "The <u>latent image stability</u> in the photoresist should be such that there is less than a 5 nm change in the CD over a 6 hour time period." (emphasis added). The "latent image" refers to the exposed pattern which resides in the photoresist after the direct writing process by the continuous wave laser.

5. The present invention relates to a method of increasing the shelf life of a blank photomask substrate. A blank photoresist substrate is one which has not been exposed to patterning radiation. This invention pertains to the ability to prepare a blank photomask substrate and to store the substrate for a significant time period prior to processing of the substrate to produce a photomask. There is no mention in the '394 patent that a method of increasing the shelf life of a blank photomask substrate has been discovered. While there is a relationship between latent image stability in a photoresist during the direct write imaging and the shelf life

of a blank photomask substrate, the invention presently claimed is distinct from the subject matter described in the '394 patent.

6. We hereby declare that all statements made herein of our own knowledge are true and that all statements made on information and belief are believed to be true; and, further, that these statements were made with the knowledge that willful false statements and the like so made are punishable by fine or imprisonment, or both, under Sec. 1001 of Title 18 of the United States Code, and that such willful false statements may jeopardize the validity of the application or any patents issued thereon.

1) 12/15/04, 2004

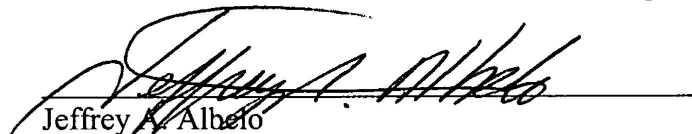


Scott Fuller

2) 12/15, 2004

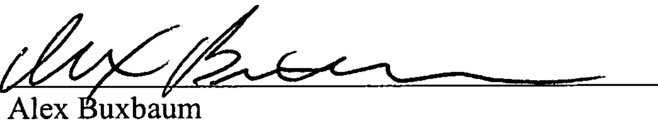
Melvin W. Montgomery

3) 12/10, 2004



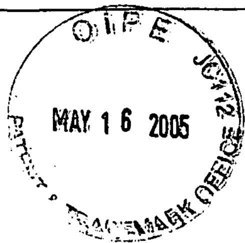
Jeffrey A. Albelo

4) 12/14, 2004



Alex Buxbaum

ET



Invention Disclosure

005852

Date received 17 January 2001
Docket no. B-5212

This invention disclosure form is to assist the employee in properly protecting the invention and to enable the Company to secure an adequate disclosure and record of the invention to be employed in accordance with the provisions of the Company Patent Policy. It is important that such form be filled out as soon as possible after conception of the idea of invention in order that priority rights to the invention may be secured. A separate form should be used for each invention or major modification thereof. After completing the form (in Word), print, sign and initial where indicated. Have witnesses read, understand and sign as well..

Submitted by:Scott Fuller
Descriptive title: DX 1100 Post Apply Bake Photomask Process
Product or project to which invention relates:ALTA X

I Inventor(s)
  a. Name Scott Fuller Citizenship USA
  Mailing address: Etec Systems 21515 NW Evergreen PKWY, Hillsboro, OR 97124

II Conception of invention
  a. Date of first drawing Where located? Hillsboro, Oregon Etec System, an Applied Materials Company
  b. Date of first written description Where located? Hillsboro, Oregon Etec Systems, an Applied Materials Company
  c. Date of first oral disclosure To whom? Etec Process Group

III Construction of invention
  a. Date completed Made by whom? Scott Fuller
  b. Has first model been retained? Yes
  c. Where can model be found? Etec Systems Hillsboro , OR

COMPUTER ENT—
JAN 2 3 2001

IV Test of device
  a. Date of test Witness Jeff Albelo
  b. Results Good

V Publication
  a. Has description been published outside the company? No
  Date of publication
  b. Title of publication:

VI Sale or public use
  a. Has device been sold? No Date
  b. Used publicly? No Date

VII Related printed publications, patents, patent applications, name or number of such material:

VIII Contracts

Signature(s) of Inventor(s) Date

Conceived? Scott Fuller Constructed? Scott Fuller Contract identifier: Scott Fuller

Purpose of Invention

(Explain the result sought to be accomplished, difficulties overcome or eliminated, and advantages to be gained by the invention.)

The invention goal is to identify the correct Post Apply Bake (PAB) Parameters (Bake Temperature, Bake Time, Cool-Time) optimizing Clariant DX 1100 CD sensitivity to Post Apply Bake (PAB) in a photomask application. Inherent in optimizing PAB is the difficulty sorting out convoluted process effects (Eg. Plate to plate CD variation, inner plate CD variation). The principle advantage is the discovery of optimum processing parameters for Clariant DX 1100 PAB on photomasks.

Point of Novelty

(State briefly and as precisely as possible the specific features in this invention which you consider to be new and which you believe have never been done before.)

1. Usage of multi-zone PAB system on Clariant DX 1100 photoresist Reference:See Control Number is temperature gradient processing of substrates including photoresist material
2. Identification of an optimum PAB process deduced from a single plate experiment. It would normally require 49 plates to obtain the same information. The DOE capability incorporated within the system was created to generate data that could be used for identifying photoresist performance characteristics. CD is the anticipated metric. There is also a patent pending on temperature gradients applied to substrates generated by
3. Clear identification of process window, PAB Temperature ranges 85-112 C (on resist surface), which minimizes CD sensitivity to PAB (CD Slope< +/- 1 nm/C). See Figure 3.
4. Optimum PAB Process Window: Temperature near100 C, Zero CD Slope

Note: Temperature shall be defined as the temperature at the ARC (Anti-Reflected Coating)/Resist interface after the completion of the ramp up cycle where system reachesfinal setpoint temperature.

Description of Invention

(In your own words describe the apparatus and mode of operation of your invention. If sketches or drawings are included herewith, make reference in your description to the numbers identifying the parts in the sketches or drawings. Include in the description any peculiar, necessary or unusual properties, characteristics or functions of such parts of the invention and any other special conditions, such as temperature, pressure, dimensions, proportions and the like, which are important to the operatives or the attainment of the purpose of the invention. Include any chemical formula or electrical computation necessary to an understanding of the invention. If possible, attach hereto all original and preliminary written descriptions of

Signature(s) of Inventor(s) Date

Experiment Description

Blanks: 6025, ARC/Chrome/Quartz film stack
Resist: Clariant DX 1100 Photoresist

Process Step
Coat
Post Apply Bake (PAB)
Exposure
Post Exposure Bake (PEB)
Develop
Post Develop CD

Table 1. Summary of experimental steps used in producing CD vs. PAB temperature data.

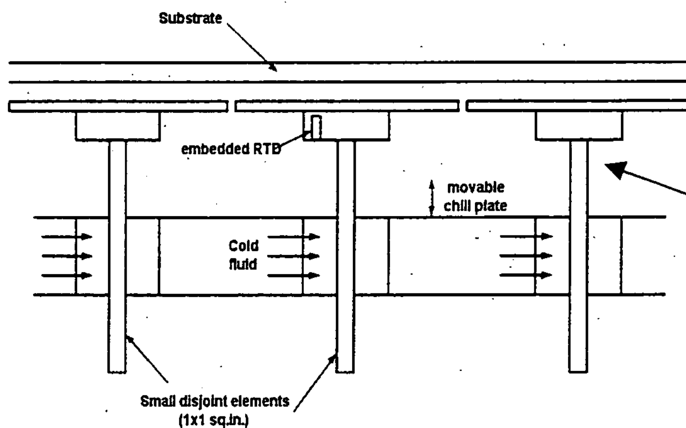


Figure 1 Zoomed in view of one zone.

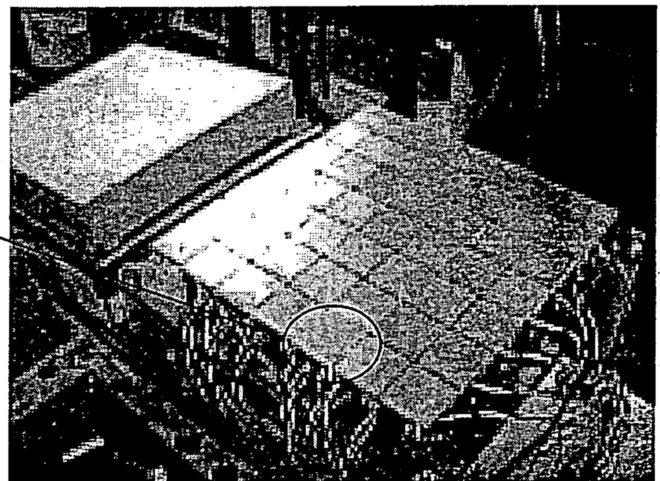


Figure 2. Prototype APT 3235 49-Zone Hot Plate. Each zone is maintained at a unique temperature

A description of the experiment is summarized in table 1. The critical step is the PAB step. During this step 49 sections of the plate were baked at different temperatures between 85-140 C. Figure 2 illustrate the baking surface. Figure 3 shows a zoomed in view of one of the 49 zones and the cooling mechanism; chilled water was used to cool the plate after baking. Each zone behaves Independently enabling each zone to effectively be a separate experiment.

Figure 3 illustrates the experimental results. On the left y-axis the Post Develop CD (space) is displayed as a function of the PAB temperature at the resist/ ARC

surface interface. The resist/ARC surface
temperature is know through the use of an independent measurement of a calibrated quartz plate with

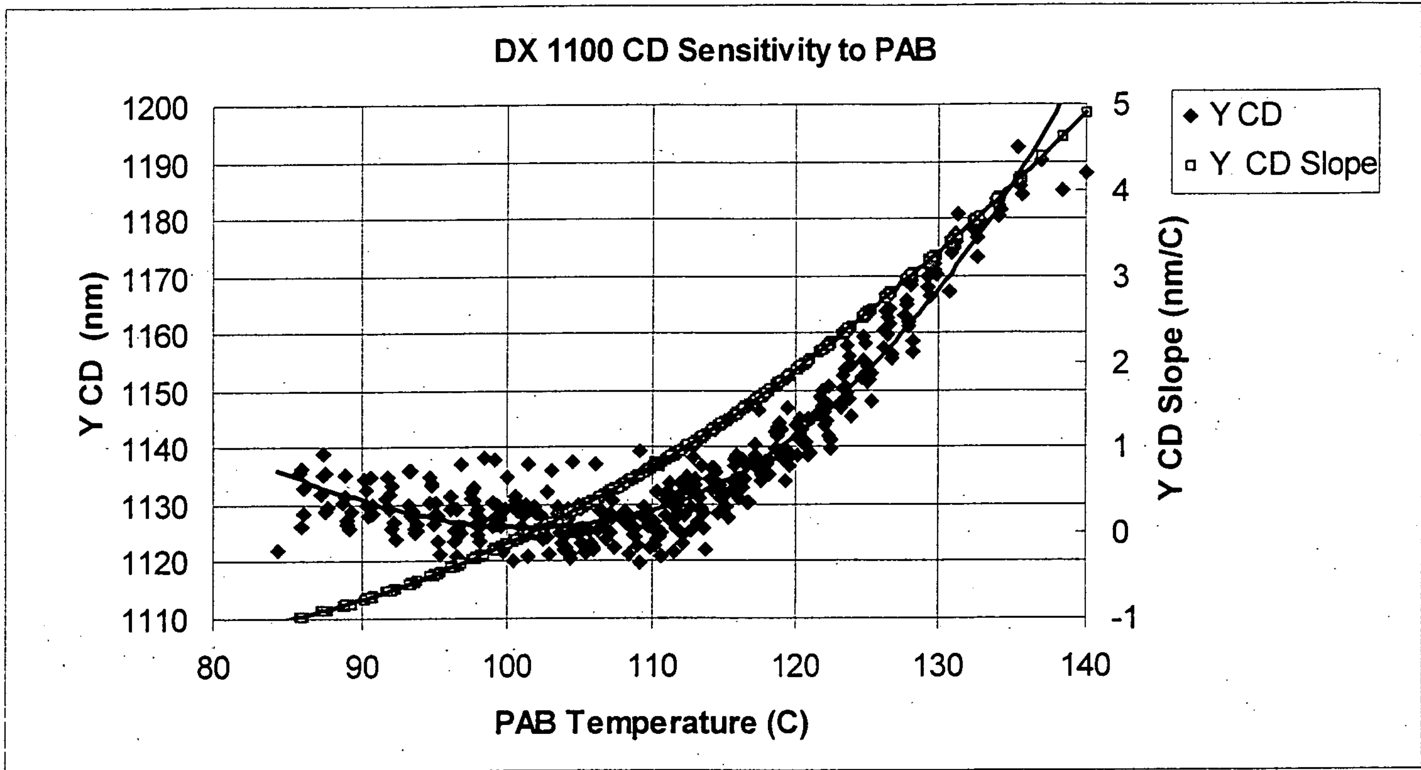


Figure 3 Clariant DX 1100 CD Sensitivity to PAB .

RTD's attached to chrome oxide surface (SenseArray Process Probe™). The right y-axis shows the derivative (slope) of left y-axis data. It can be seen that a zero slope condition, (optimum process set point) exists near 100 C , and +/- 1 nm/C sensitivity occurs between a temperature 85-112C.

Prior Art List known literature and patents which pertain to this invention's precedents.)

Signature(s) of Inventor(s) Date

1. US5723237: Method for determining baking conditions for resist pattern formation through development of unexposed trial resists films.
2. Control Number

Witnessed, Read and Understood by:

____________________	____________	____________________	____________
	Date		Date

Inventors' Initials ____________________